

# SERVICE MANUAL



**Document 780038**

**Revision D**

## **GE Signa<sup>o</sup> Ovation<sup>TM</sup> MARK 5000 PHASED ARRAY SHOULDER COIL**

**GE Catalog Part Number: M20062BC**

**USAI Part Number: 160055**

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## DAMAGE IN TRANSPORTATION

All packages should be closely examined at time of delivery. If damage is apparent, have notation "**damage in shipment**" written on **all** copies of the freight or express bill **before** delivery is accepted or "signed for" by a General Electric representative or a hospital receiving agent. Whether noted or concealed, damage **MUST** be reported to the carrier **immediately** upon discovery, or in any event, within **14** days after receipt, and the contents and containers held for inspection by the carrier. A transportation company will not pay a claim for damage if an inspection is not requested within this **14** day period.

**Immediately** complete a "Damage Loss Claim Form", available via MS Exchange Mail, after the damage is found.

MS Exchange Path:

Outlook/Public Folder/All Public Folders/Medical Systems/!Global Initiatives/Information Management/Forms/Common Forms/DAMAGE LOSS CLAIM FORM.

Send the completed form to the email address listed in the form.

For more information about the Transportation Claim Procedure, access the GE Medical Systems Intranet and enter the following URL address (case sensitive):

<ftp://3.87.40.2/globepro/qualsys/Docs/190016MF.PDF>

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- 未详细阅读和完全了解本手册之前，不得进行维修。
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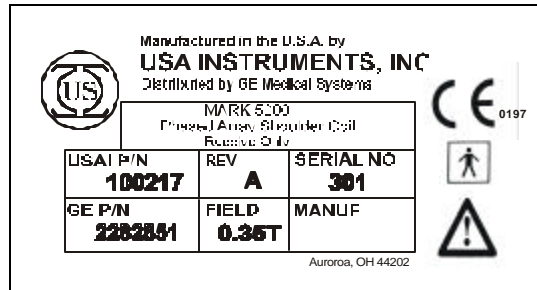
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**SECTION 1 – INTRODUCTION**

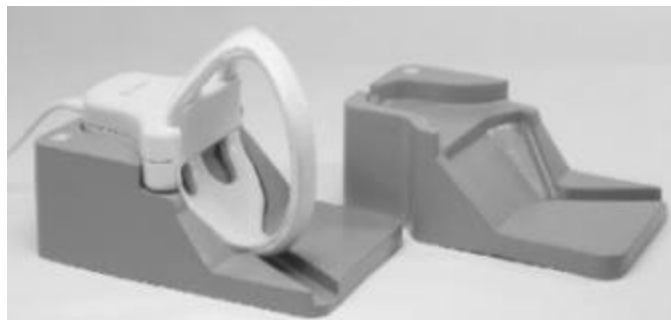
**1-1 Product Identification and Shipping List**

To identify the Mark 5000 Phased Array Shoulder Coil, refer to the coil label underneath the coil (as shown in *Figure 1*).



*Figure 1: Coil label.*

*Figure 2* shows a picture of the Mark 5000 Phased Array Shoulder Coil.



*Figure 2: The Phased Array Shoulder Coil.*

**SHIPPING LIST – TABLE 1-1**

Part Name	GE Part #	USAI Part #	Qty
Coil	2282851	100217	1
Support Pad (Left)	E8801TG	150072	1
Support Pad (Right)	E8801TH	150071	1
Phantom Positioner	2264743-5	150111	1
Operator's Guide	2282841	770058	1
Service Manual	2284557	780038	1

## 1-2 Compatibility

This coil is compatible with the Signa<sup>®</sup> Ovation<sup>™</sup> 0.35T system.

## 1-3 Related Documentation

Operator's Guide, GE Part Number 2282841.

Signa<sup>®</sup> Ovation<sup>™</sup> MR Service Document CD-ROM 2283084.

## 1-4 Environmental Requirements

### Storage Requirements

Coil should be stored in the scanner room.

### Dimensions

37.45 cm x 23.11 cm x 23.69 cm (14.75" x 9.10" x 9.33")

### Weight

4.05 kg (9 lbs.)

## 1-5 Theory of Operation

The physical layout of the Mark 5000 Phased Array Shoulder Coil is shown in *Figure 3*. The block diagram of the coil is shown in *Figure 4*. The coil is designed for imaging the shoulder and surrounding regions. The sensitive region of the coil offers approximately 25cm field of view. The device consists of two quadrature receive coils.

The Phased Array Shoulder Coil is a receive-only coil as shown in the schematic in the Appendix. The coil is actively decoupled from the RF transmit coil during transmit by means of a RF choking circuit. The choking circuit elements are switched on by pin diodes. The pin diode is turned on by a forward biasing DC current source supplied by the MRI system (active decoupling). When the pin diode is turned on, the impedance of the RF choking circuit becomes very high (typically above 2 kilo-ohm), compared to the other circuit elements (less than 25 kilo-ohm). These high impedance elements segregate the coil circuitry into two isolated electrical segments, preventing any current flow in the coil circuit.

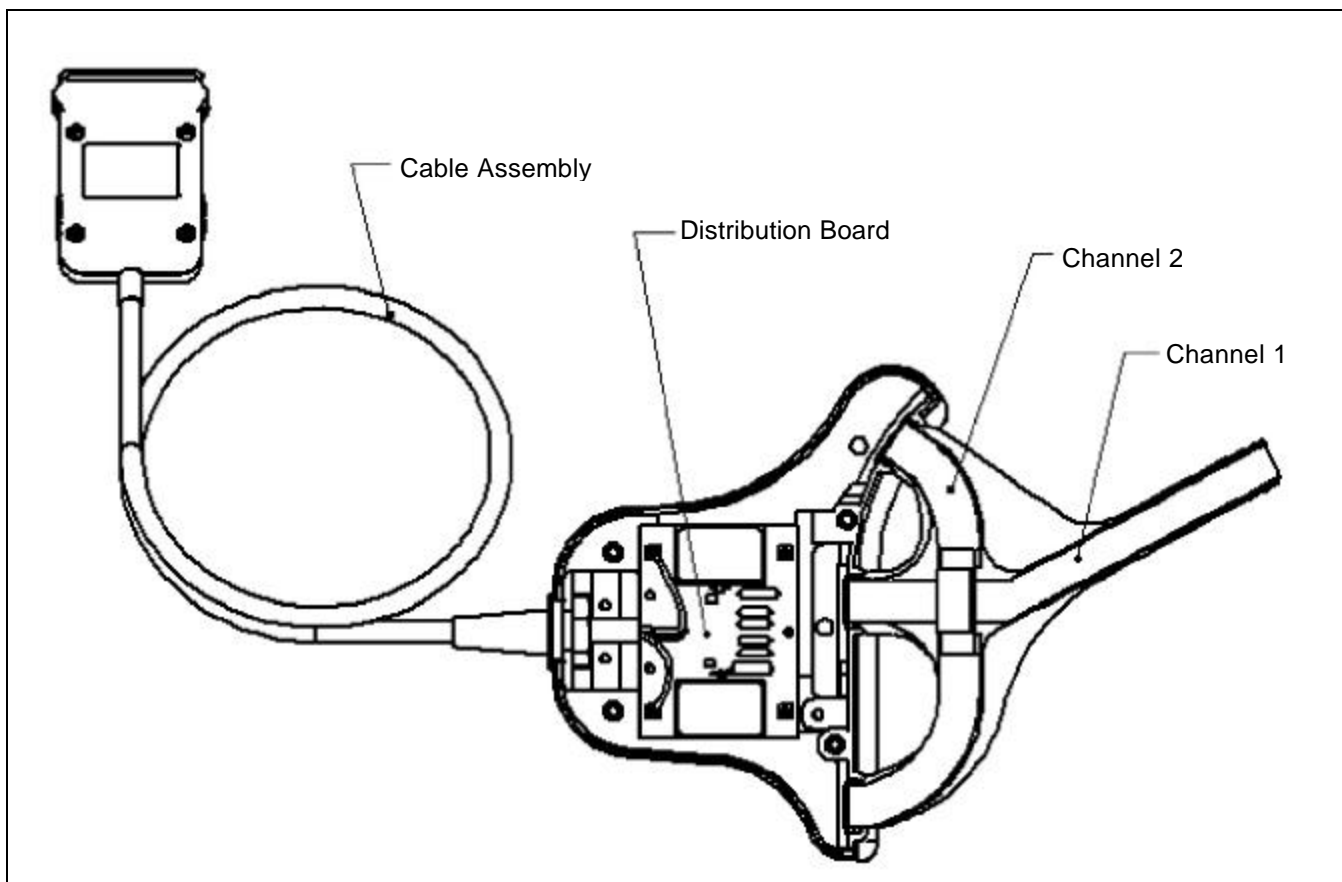


Figure 3: Coil physical layout.

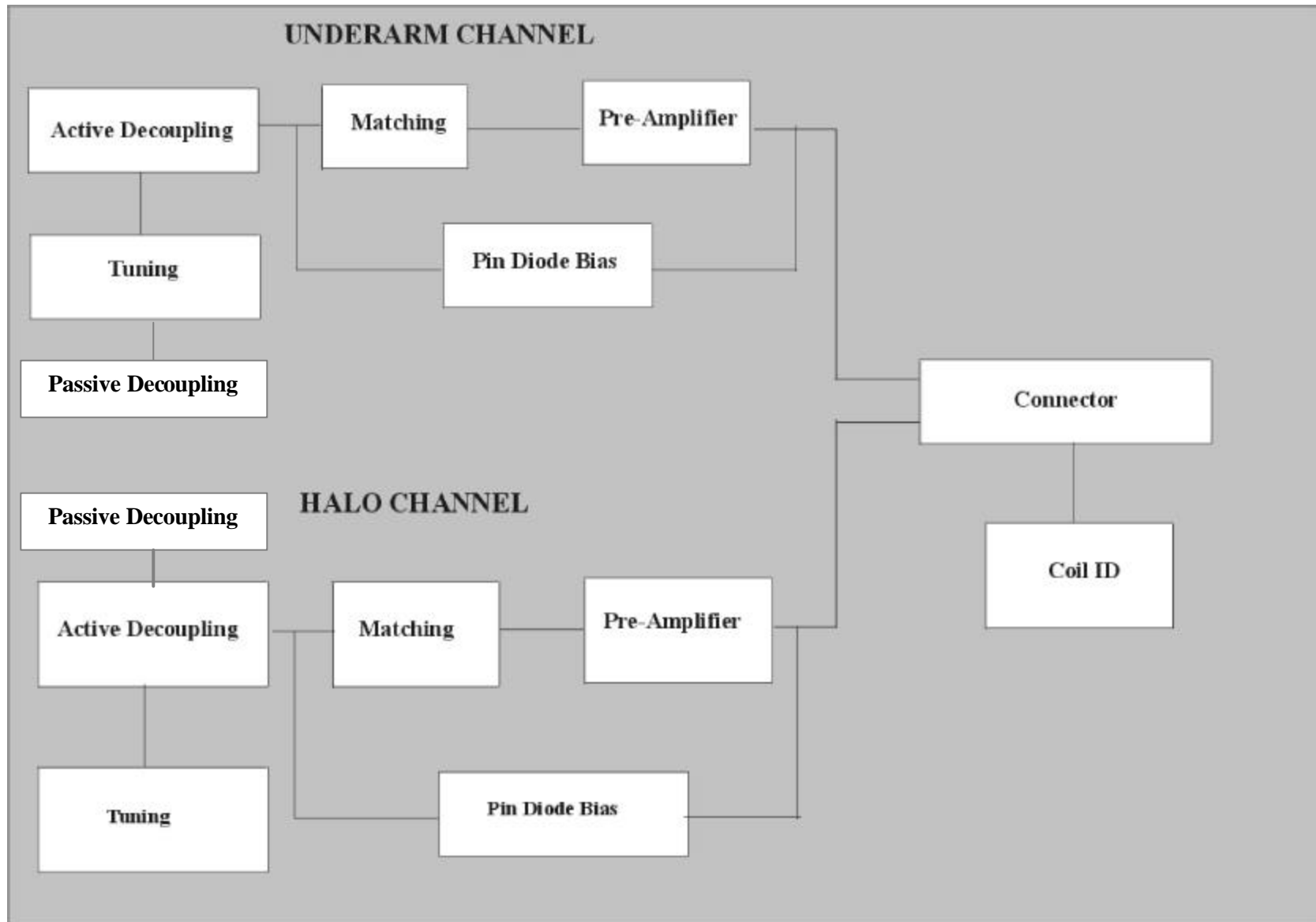


Figure 4: Block diagram of the coil.

## SECTION 2 – SETUP AND CALIBRATION

### 2-1 Coil Installation

#### 2-1-1 Special Install Notes

None.

#### 2-1-2 Configuration

The system will automatically recognize the coil using the Coil ID feature. No configuration should be required. If the system does not automatically recognize the coil, install the configuration information. For reference, the configuration information is included in the Appendix; however, that configuration is only current as of the printing of this manual.

#### 2-2 Installation Functional Checks

1. From the Scan Desktop, start new scan by selecting **[New Pt]**; set **Patient ID** to “geservice” and **Patient Weight** to “111” pounds. Click **[Patient Position]** to open protocols window.
2. Plug the coil into the patient table and verify the coil indicator light at the side of the coil port turns green. A green light indicates the system hardware identifies the coil.
3. At the console, verify the Coil has been properly identified by the system: correct name in **Coil** field and correct picture on the screen.
4. Perform system level Signal to Noise Check. Refer to Service Methods CD; System Level Procedures; Functional Checks; Signal to Noise Check.
5. Perform Section 3-2 Coil Imaging Performance Verification.

#### 2-3 Periodic Quality Assurance Check

On a periodic basis, such as during planned maintenance, perform the quality assurance checks as outlined below to ensure the coils is operating properly.

1. Check external cable for cracks or cuts.
2. Perform Section 3-2 Coil Imaging Performance Verification and record the data values in the Data Sheet.

### SECTION 3 – FUNCTIONAL CHECKS

#### 3-1 Scanner Verification

Perform system level Signal to Noise Check. Refer to Service Methods CD; System Level Procedures; Functional Checks; Signal to Noise Check.

#### 3-2 Coil Imaging Performance Verification

##### 3-2-1 Tools Required

**TOOLS REQUIRED – TABLE 3-2-1**

Description	GE Part #	USAI Part #	Qty
Phantom Positioner	2264743-5	150111	1
TLT Head Sphere*	46-265826G6	N/A	1

*\*Note: TLT head sphere comes with the system, not as part of the coil.*

##### 3-2-2 Explanation of Procedure

The image quality check uses the subtraction method to calculate SNR. The method requires two scans to create two phantom images. The signal value is measured from two images, and the noise value is measured from one subtracted image that is generated from two phantom images.

##### Symbols for Hardware and Software Keys

Hardware keys are underlined>. Software keys are indicated using brackets [ ].

##### 3-2-3 Signal Scan

1. Select [New Pt] to set a new landmark.

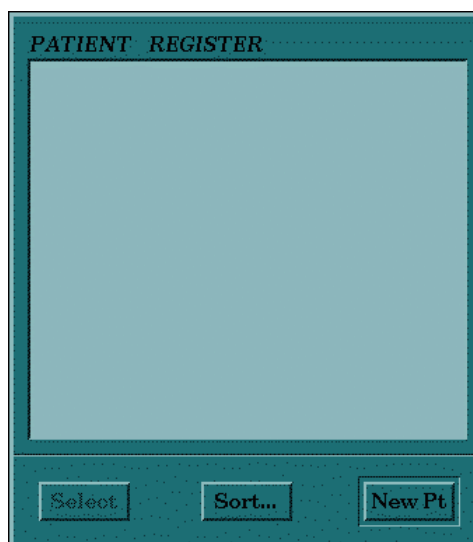
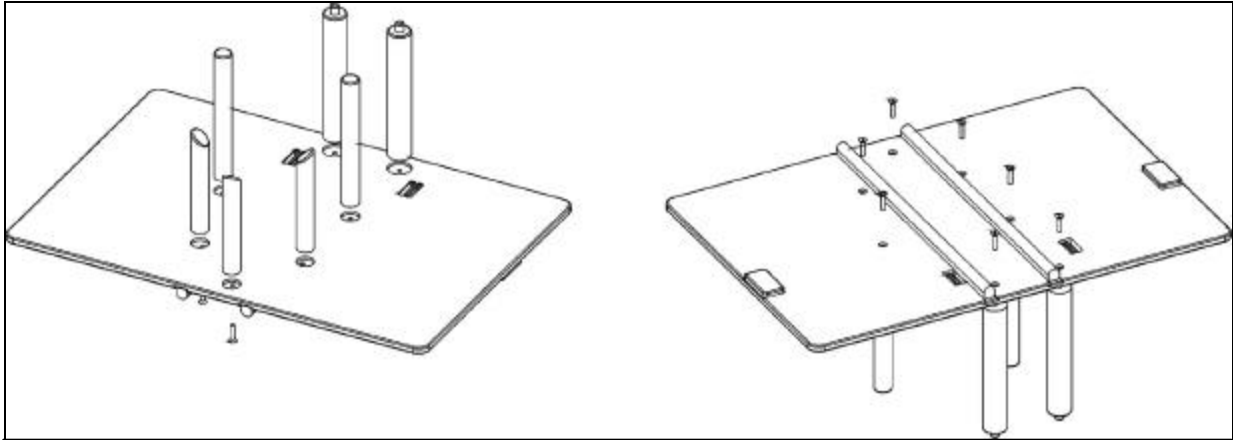


Figure 5: New patient setup.

2. Remove any other surface coils (if present) from the cradle.
3. Place the GE 18cm TLT sphere phantom (GE Part #46-265826G6) and positioner (see *Figure 6* for assembly instructions) on the cradle.



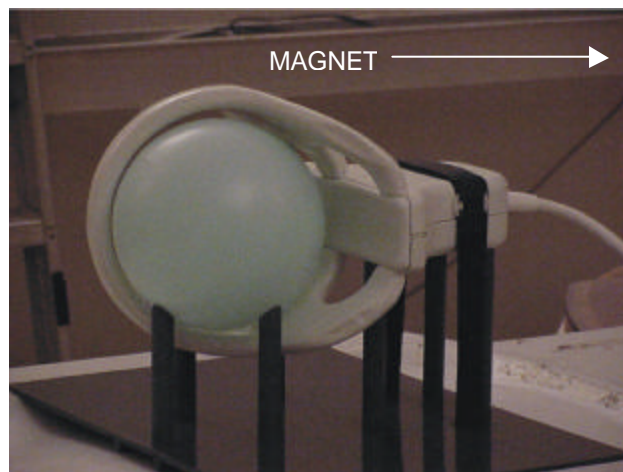
Step 1 – Assemble the two large diameter posts (with small diameter posts on top) to the phantom positioning plate using the brass screws provided. The two large diameter posts will fit into the two large diameter pockets of the plate.

Step 2 – Assemble the three small diameter posts (with angled top) to the phantom positioning plate using the brass screws provided. These three posts have the mounting holes offset from the center of the rod so they can only be assembled in the three holes in the plate that have the corresponding offset mounting holes.

Step 3 – Assemble the two small diameter posts (with flat top) to the phantom positioning plate using the brass screws provided. The two flat top small diameter posts fit into the remaining pockets on the positioning plate.

*Figure 6: Assembling the phantom positioner.*

4. Place the coil on the positioner (see *Figure 7*).



*Figure 7: Positioning the phantom.*

- To avoid SNR dispersion, the coil element should touch to the phantom positioner pole (see *Figures 8 and 9*).

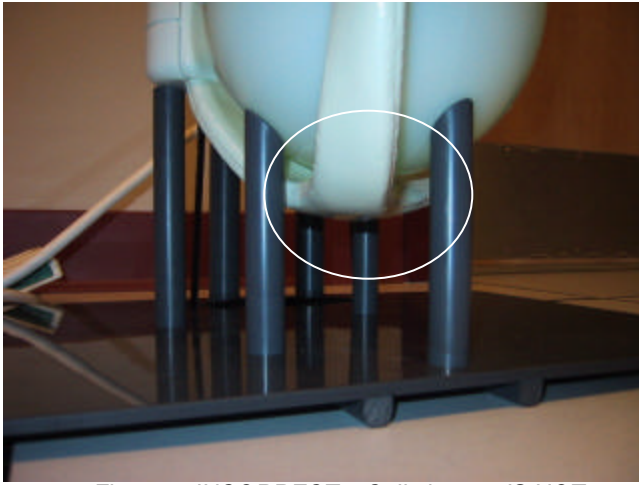


Figure 8: INCORRECT – Coil element IS NOT touching the phantom positioner pole.

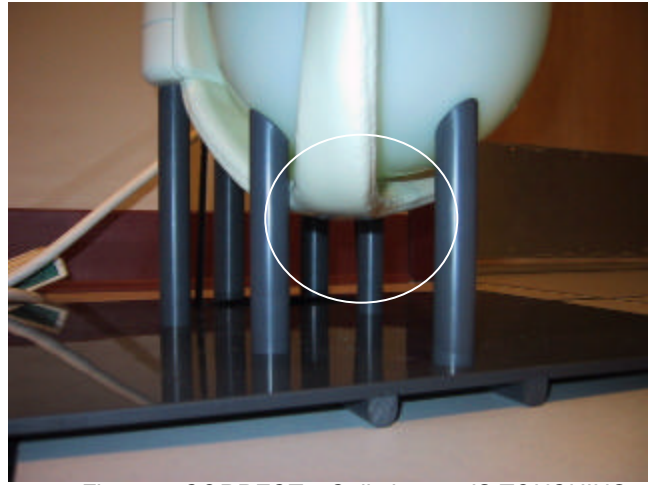


Figure 9: CORRECT – Coil element IS TOUCHING the phantom positioner pole.

- Connect the coil connector box to the coil port.
- Position the alignment light as shown in *Figure 10*.

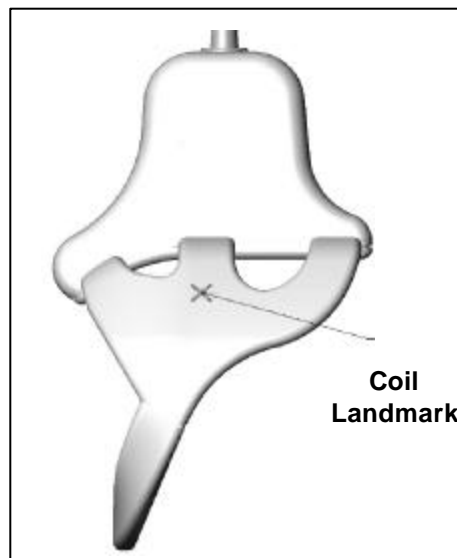


Figure 10: Coil landmark.

- Enter “geservice” for [Patient ID].
- Enter “QA Scan” for [Patient Name].

**PATIENT INFORMATION**

Accession Number

Patient ID

Patient Name

Birth Date  Age

Sex  Weight  Lb  Kg

Rad  Refer

Operator  Status

Exam Description

History

Figure 11: Patient information.

10. Enter “111” lbs or “50” kg for [**Weight**].
11. Enter the parameters from the Scan Protocols – Table 3-2-3.
12. Click [**Save Series**].

**SCAN PROTOCOLS – TABLE 3-2-3**

<b>Patient/Exam Information</b>			
Patient ID	geservice		
Patient Name	QA Scan		
Patient Weight	111 lbs. (50 kg)		
<b>Patient Position</b>			
Patient Position	Supine		
Patient Entry	Head First		
Coil	Shoulder		
Series Description	<i>Leave Blank</i>		
<b>Imaging Parameters</b>			
Plane	Coronal		
Mode	2D		
Pulse Seq	Spin Echo		
Imaging Options	None		
PSD Name	<i>Leave Blank</i>		
Protocol	<i>Leave Blank</i>		
<b>Scan Timing</b>			
# of Echoes	1		
TE	25.0		
TR	500		
Bandwidth	10.42		
<b>Additional Parameters</b>			
<i>no entries required in this area</i>			
<b>Acquisition Time</b>			
Freq	256		
Phase	256		
NEX	1.0		
Phase FOV	1.0		
Freq. DIR	S/I		
Auto Center Freq	Peak		
Autoshim	On		
Phase Correct	On		
Contrast	Off		
<b>Scanning Range</b>			
FOV	25		
Slice Thickness	5		
Spacing	0		
	<b>P/A Center</b>	<b>S/I Center</b>	<b>R/L Center</b>
<b>Start</b>	0	i80	0.0
<b>End</b>	0		
<b># Slices</b>	1		

### 3-2-4 Phantom Scan

1. Choose the saved series and select **[Prepare to Scan]**.
2. When the **[Move to Scan]** button on the keyboard flashes, press it.

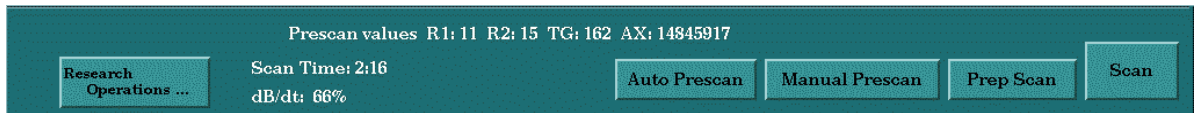


Figure 12: Auto Prescan.

3. Select **[Auto Prescan]**.
4. Select **[Scan]**.
5. Wait for the scan to finish before proceeding.
6. After the first scan, select **[Scan]** again.

### 3-2-5 Create Subtraction Images

1. Select **[Display Icon]** to display the Browser.
2. Select the exam named "QA Scan."
3. After the phantom scan, select **[Add / Sub]** from the browser.

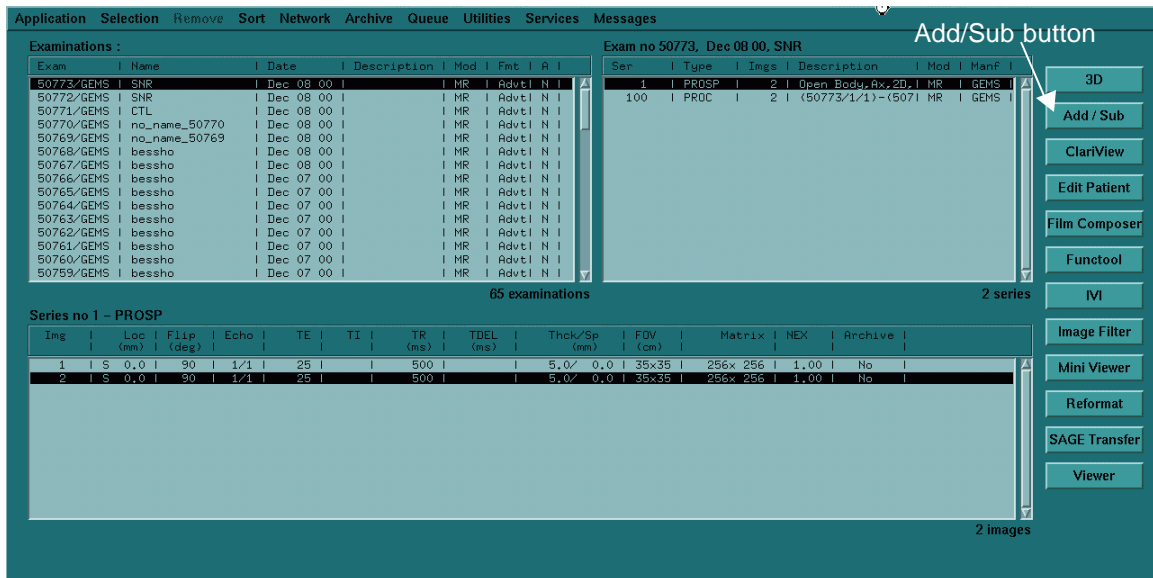


Figure 13: Browser with Add/Sub button.

4. Select MODE [-] and Check **[Accept Negative Pixels]**.
5. Select image #1 from browser and select **[Select Set]** (left button on the Image Combination window).
6. Select image #2 from the browser and select **[Select Set]** (right button on the Image Combination window).
7. Select [=].

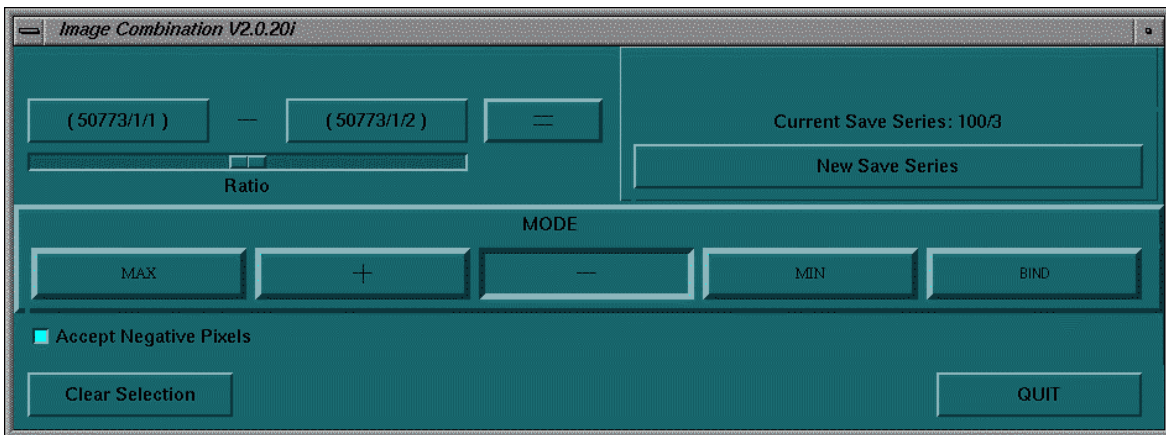


Figure 14: Image Combination Window.

### 3-2-6 Setting the Cursor

1. Select [**Display Icon**] to display the Browser.
2. Select the exam named “QA Scan”.
3. Select image #1 from the browser and select [**Mini Viewer**].
4. Select [**Grid**] to set the cursor.
5. Select [**Measure**] then select circular cursor and set the cursor to circle with  $3000\text{mm}^2$  ( $\pm 100\text{mm}^2$ ). Use cursor copy (**CTRL + C**) and paste (**CTRL + V**) to easily set the cursor to each image.
6. Set the cursor at the center of the phantom.

### 3-2-7 SNR Image Analysis

#### Signal Measurement

1. Measure the mean value of image #1 and record it on the SNR worksheet in the Appendix.
2. Open image #2 from the browser and measure the mean value.

#### Noise Measurement

1. Select subtracted image in the browser with [**Mini Viewer**]. The series of subtracted images are 100s.
2. Record the SD value using the same diameter ROI on the SNR Worksheet in the Appendix.

For the signal and noise measurements, choose an ROI following the examples shown in Figures 15 through 17.

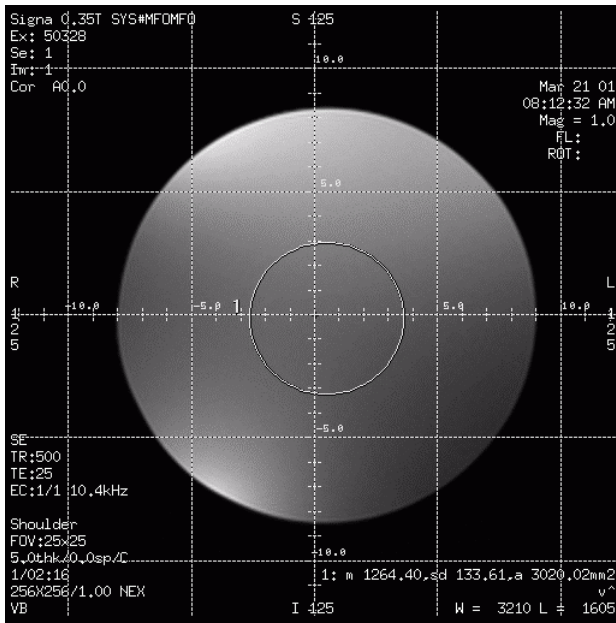


Figure 15: First composite image #1.

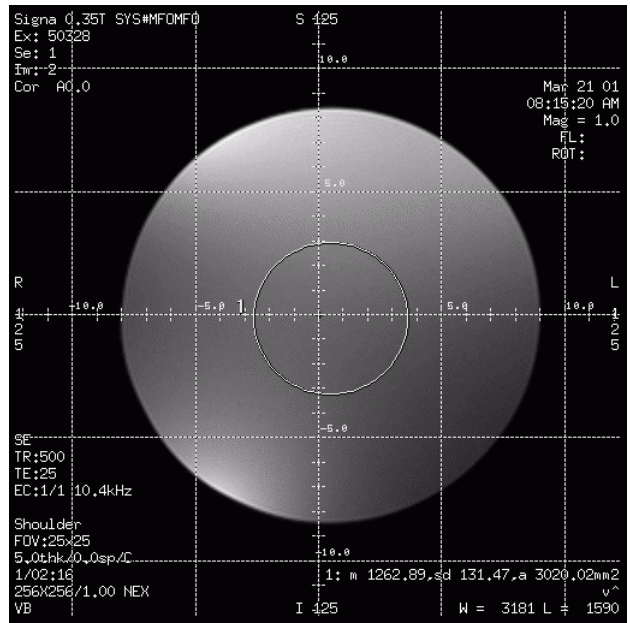


Figure 16: Second composite image #2.

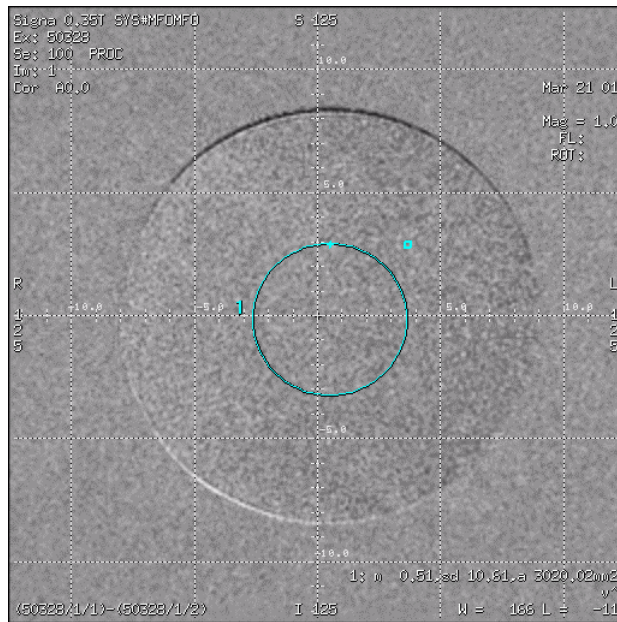


Figure 17: Subtraction image of composite images.

### SNR Measurement

SNR is calculated as follows:

$$SNR = [(mean\ value1) + (mean\ value2)] / (SD \times 1.414)$$

### SNR Specification

The SNR should be greater than or equal to 155.

### 3-3 External Cable Check

Step 1 – Using a Digital Multimeter, select the **Diode Test** function.

Step 2 – Refer to the Step 1 column of Expected Readings – Table 3-3 for lead placement.

Step 3 – Flex the external cable, especially near the connectors and the strain relief. A reading of **1.200 to 1.800** should remain on the Digital Multimeter with no instability or fluctuations.

Step 4 – If the check in Step 3 fails, replace the coil.

Step 5 – Refer to the Step 2 column of Expected Readings – Table 3-3 for lead placement.

Step 6 – Flex the external cable, especially near the connectors and the strain relief. A reading of **infinity** should remain on the Digital Multimeter with no instability or fluctuations.

Step 7 – If the test in Step 6 fails, replace the coil.

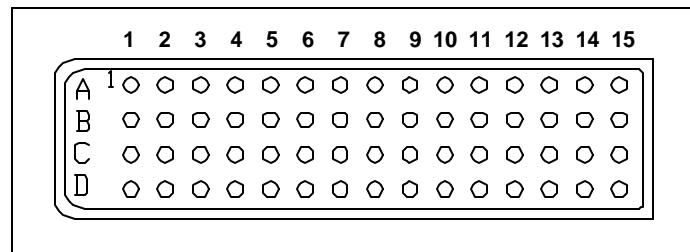


Figure 18: Connector diagram.

### EXPECTED READINGS – TABLE 3-3

Cable	Positive Lead Connection		Negative Lead Connection	
	For Step 1	For Step 2	For Step 1	For Step 2
Underarm Loop (PA2)	D2	D15	D15	D2
Halo Loop (PA4)	D4	D15	D15	D4

### 3-4 PIN Diodes Check

Step 1 – Using a Digital Multimeter, select the **Diode Test** function.

Step 2 – Refer to the Step 1 column of Expected Readings – Table 3-3 for lead placement.

Step 3 – The reading on the Digital Multimeter should be between **1.200 and 1.800**. If the reading is below 1.200, either the output cable is shorted or there is a defective PIN diode. If the reading is above 1.800, there is a defective PIN diode. If the reading is **infinity**, either the output cable is open, or a PIN diode is open.

Step 4 – Refer to the Step 2 column of Expected Readings – Table 3-3.

Step 5 – The reading on the Digital Multimeter should be **infinity**.

### 3-5 Mechanical Hardware Check

None.

### 3-6 Troubleshooting Tips

Symptom #1: The system reports a coil fault during prescan or does not recognize the coil connection to the system when selected in the software.

Probable Cause	Suggested Actions	Resolution
The coil connector has become disconnected from the system interface.	Check to make sure the coil connector is fully engaged.	Engage connector and try the scan again. Make sure the indicator light on the patient table turns green with the proper coil selected on the console.
There is a DC short or open somewhere within the DC path inside the coil.	Check each channel using Expected Readings – Table 3-3. Check the coil and associated DC paths with a DVM, in both diode check and resistance modes.	If a short or open is observed, check the output cable by itself (see below). If the cable and PIN diodes are okay, then replace the coil.
The output cable has a short or an open.	Disconnect the cable at the coil and check each coaxial line with a DVM (resistance). Try moving and twisting the cable as you watch the meter to find any intermittent connections. Inspect the center pins of the SMB and Bendix connections for wear and proper engagement into the mating connection.	Replace the coil.
There is a problem with the DC bias from the system interface or the coil ID circuitry.	Check to ensure the correct DC bias is being provided to the coil during transmit and receive per GEMS System Service Manual. Try a similar 2-channel coil to see if the same problem occurs.	Correct MRI system problem.

Symptom #2: The coil does not pass SNR tests or exhibits poor image quality on patient scans.

Probable Cause	Suggested Actions	Resolution
One or more of the coil channels has a high noise level.	Look at the uncombined images to determine which channel has the problem. Compare the noise standard deviation measurements between channels and system performance logs; they should be approximately the same.	Replace the coil.
One or more of the coil channels has low signal.	Look at the uncombined images to determine which channel has the problem. Compare signal mean measurements between channels and system performance logs.	Replace the coil.
Excessive ghosting is causing the noise std. dev. measurements to be artificially high.	Window and level the images down to look at the background for signs of ghosting. Try padding the phantom in the holder.	If padding or changing the phantom position can minimize ghosting, then the problem is caused by excessive vibration elsewhere in the system. If the ghosting is not symptomatic of phantom positioning or padding, then replace the coil.
There is a problem with the DC bias from the system interface or the coil ID circuitry.	Check to ensure the correct DC bias is being provided to the coils during transmit and receive per GEMS System Service Manual.	Correct MRI system DC bias problem.

**Coil Element Information**

element name	not used	loop 1	not used	loop 2	not used	not used	not used	not used	not used
channel number	1	2	3	4	5	6	7	8	N/A
selected channel	no	yes	no	yes	no	no	no	no	N/A
mc bias driver #	1	1	2	2	3	3	4	4	N/A
active bias driver	yes	yes	yes	yes	no	no	no	no	N/A

## SECTION 4 – MAINTENANCE

### 4-1 Coil Care

**WARNING!**

**Detach the coil connector box from the system before attempting to clean the coil. Do not reattach the connector box after cleaning until the coil has dried completely. Electrical shock may result if the coil is attached to the system during cleaning or when it is wet.**

**CAUTION**

**Do not spray or pour cleaning solution directly on the coil. Do not submerge the coil in the solution. The coil contains sensitive electronic components that could be damaged by the solution.**

The following solutions are recommended for the coil and pad surfaces: (1) a 10% bleach solution (some discoloration may occur), (2) one ounce (29.6 ml) commercial dishwashing liquid mixed with one gallon (3.8 l) of water or (3) warm water. Apply cleaning solution to a soft cotton cloth and proceed to clean. To prevent soiling of the coil, the user should place a cotton sheet over the coil before positioning the patient. If the coil is soiled, clean the coil as described above.

### 4-2 Special Care Requirements

Prior to returning a coil for service, use a 10% bleach solution (as described above) to eliminate risk of exposure to potentially infectious materials.

## SECTION 5 – REPLACEMENT

Simple removals that are clearly obvious are not described here.

Unless otherwise noted, the steps for re-assembly are simply the reverse order of the steps described for disassembly.

### 5-1 External Cable Replacement

Step 1 – Remove coil cover.

Step 2 – Remove the 2 (two) screws near the cable strain relief (refer to *Figure 19*).

Step 3 – Remove the SMB connectors (W1 and W12) and 4-pin molex connector from the preamp PCB assembly.

Step 4 – Remove the cable assembly from the coil assembly.

Step 5 – Install the new cable assembly.

Step 6 – Connect the cable connectors W2 to the jack on the board labeled W2 and the cable labeled W12 to the jack on the board assembly labeled W12.

Step 7 – Install the covers.

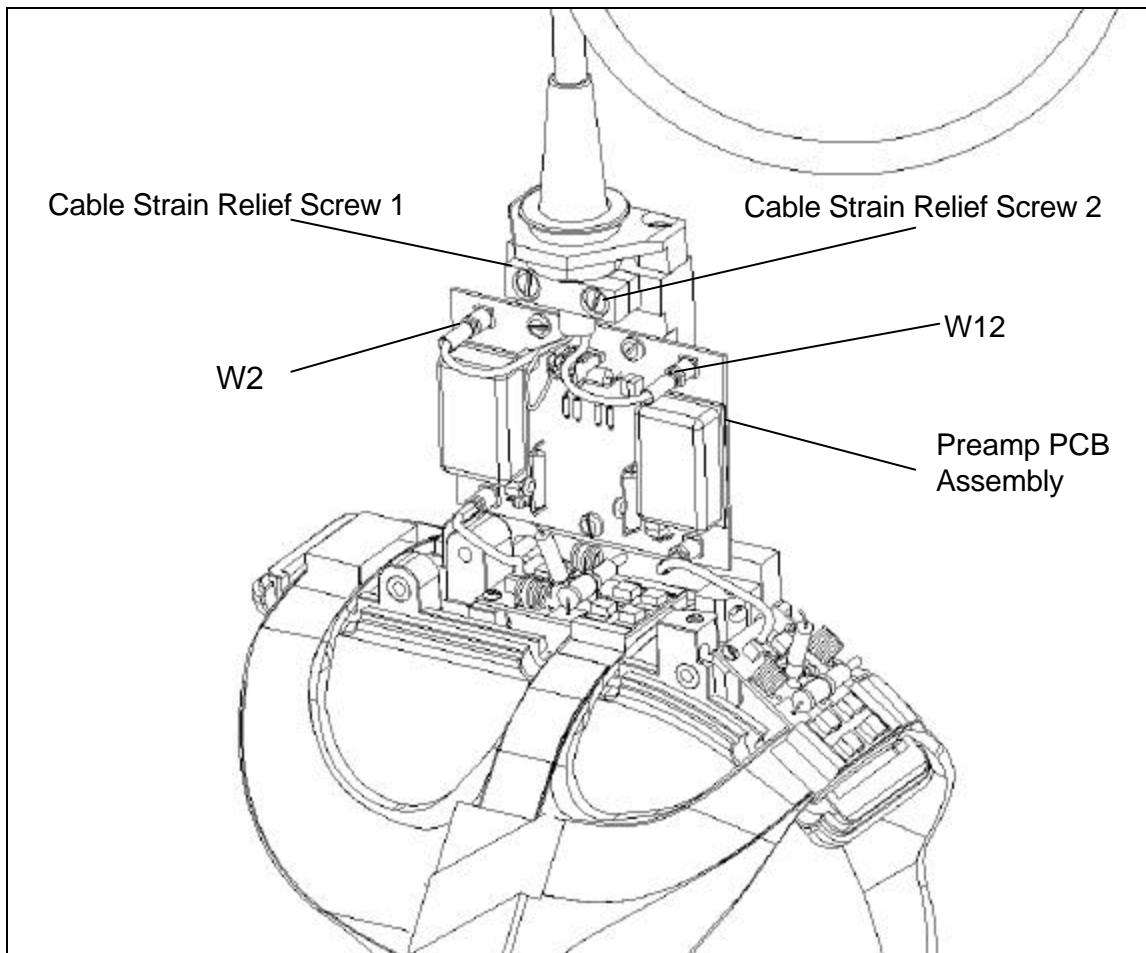


Figure 19: Cable assembly.

## SECTION 6 – RENEWAL PARTS

### 6-1 Field Replaceable Units

**FIELD REPLACEABLE UNITS LIST – TABLE 6-1**

Part Name	GE Part #	USAI Part #
Coil	2282851	100217
Cable Assembly	2284553	110087
Phantom Positioner	2264743-5	150111

### 6-2 Other Replaceable Accessories

**OTHER REPLACEABLE ACCESSORIES LIST – TABLE 6-2**

Part Name	GE Part #	USAI Part #
Support Pad (Left)	E8801TG	150072
Support Pad (Right)	E8801TH	150071
Coil Shipping Container Set		150112

**SECTION 7 – APPENDIX**

**7-1 SNR Data Sheet**

Use the table provided below to record the calculated signal to noise ratio (SNR) data obtained from the Functional Checks Section.

Date Tested	Configuration	Signal Mean 1	Signal Mean 2	Noise SD from Subtraction Image	SNR	Spec Limit
	Shoulder					=155
	R1=		R2=			
	TG=		Freq=			

Date Tested	Configuration	Signal Mean 1	Signal Mean 2	Noise SD from Subtraction Image	SNR	Spec Limit
	Shoulder					=155
	R1=		R2=			
	TG=		Freq=			

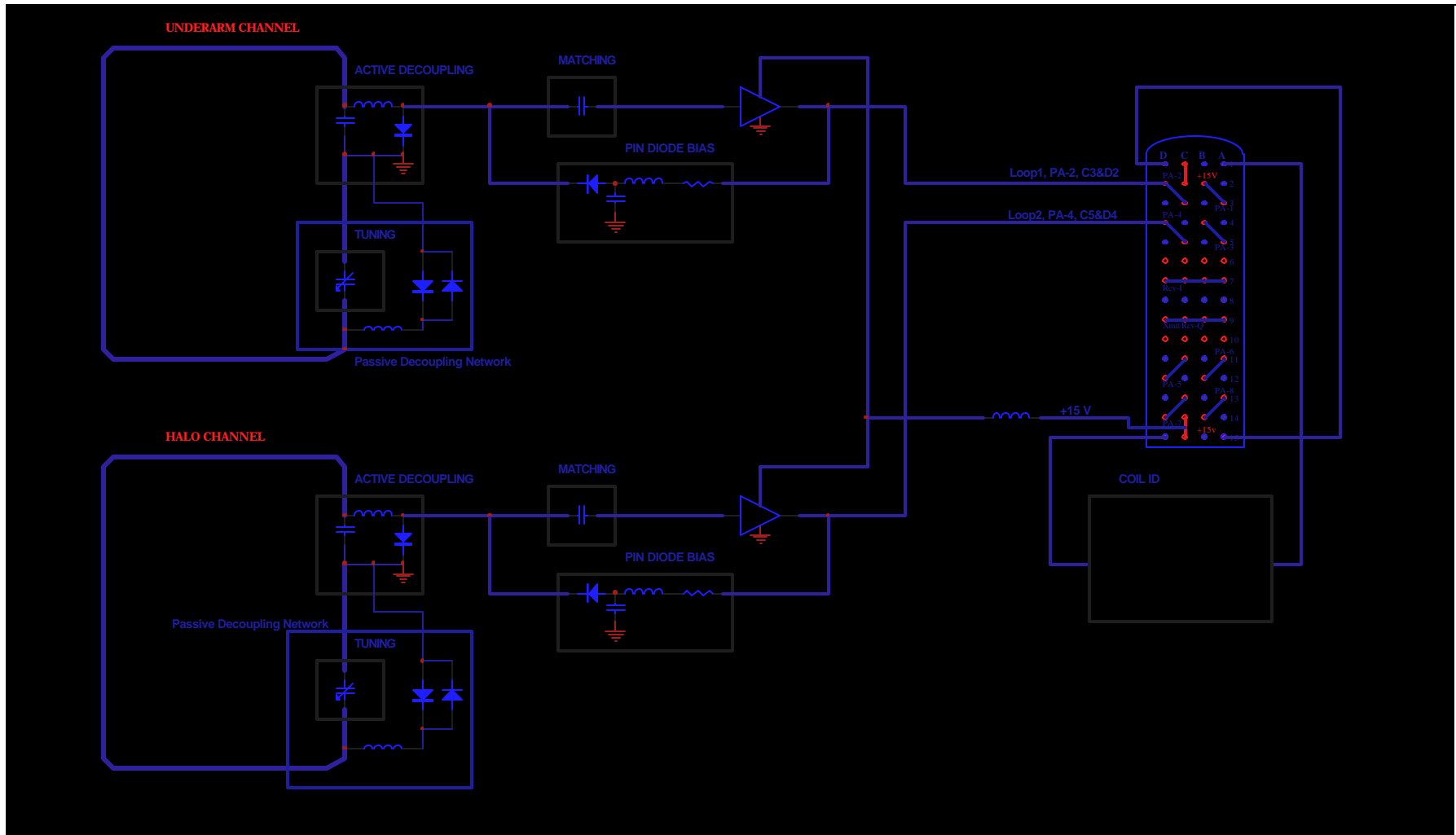
Date Tested	Configuration	Signal Mean 1	Signal Mean 2	Noise SD from Subtraction Image	SNR	Spec Limit
	Shoulder					=155
	R1=		R2=			
	TG=		Freq=			

Date Tested	Configuration	Signal Mean 1	Signal Mean 2	Noise SD from Subtraction Image	SNR	Spec Limit
	Shoulder					=155
	R1=		R2=			
	TG=		Freq=			

Date Tested	Configuration	Signal Mean 1	Signal Mean 2	Noise SD from Subtraction Image	SNR	Spec Limit
	Shoulder					=155
	R1=		R2=			
	TG=		Freq=			

Date Tested	Configuration	Signal Mean 1	Signal Mean 2	Noise SD from Subtraction Image	SNR	Spec Limit
	Shoulder					=155
	R1=		R2=			
	TG=		Freq=			

### 7-2 Schematic



### 7-3 Coil Configuration

Coil Name	Shoulder
Coil Code	USAISHOULDER
Coil Type	3
Extremity Coil	no
Cable Loss	1
Coil Loss	1.165
Recon Scale Factor	0.7
Linear vs. Quadrature	1
Multiple Receiver Coil	yes
Number of Receivers	2
Starting Receiver ID	0
Ending Receiver ID	1
Multi-Coil Port Enable	3
Multi-Coil Port Error Enable	3
Additional Transmit Attenuation	0
Number of Fast Receivers	0
Starting Fast Receiver ID	4
Ending Fast Receiver ID	4
Fast TG Start TA	90
Fast TG Start RG	12
Multi Coil Recon Enable	0
Multi Coil Channel Selection	10
Attenuation-Q	0
Attenuation-I	0
Select Quadrature Shifter	0
Phased Array T/R Coil for Autoslim	-1
Head Default Freq Dir	0
quadRcvCoil	0
cfoption	1

## REVISION HISTORY

Rev	Date	Author	Primary Reason for Change
A	05/23/01	Reva Zaretsky	First Issue
B	10/01/01	Reva Zaretsky	Revisions to Configuration Table
C	12/01/01	Reva Zaretsky	Addition to Configuration Table
D	02/15/02	Reva Zaretsky Linda Foust	Revision to SNR Data Sheet; Addition of SNR Specification